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COMPLETE SPECIFICATION

Improved Process and Apparatus for the Production of Composite Yarns

We, CELANESE CORPORATION OF AMERICA, of 180 Madison Avenue, New York 16, New York, United States of America, a Company incorporated in accordance with the Laws of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process and apparatus for the production of composite yarns and relates more particularly to the production of the type of composite yarns known as core yarns.

Core yarns are textile structures which generally consist of a core material, usually a strong fine yarn formed of a plurality of continuous filaments or staple fibres, more or less hidden within an outer layer of staple fibres drafted and twisted around the core material. Such core yarns have been produced by a process termed "Belgian doubling" which is carried out on a spinning frame comprising a set of pairs of drafting rolls (including a pair of front rolls) and a twisting and winding device such as a ring twister. A roving of staple fibres is led through the drafting rolls to the nip of the front rolls while the thread which is to constitute the core material is led directly to the nip of the front rolls, by-passing the other drafting rolls. The core material and the drafted roving are twisted together as they proceed from the nip of the front rolls to the spinning bobbin of the twisting and winding device.

Core yarns produced by the "Belgian doubling" process described above are liable to be unsatisfactory in that the outer staple fibres do not completely cover the core material, particularly when the core yarn is of medium or fine count. This defect is especially noticeable when the core material and the covering fibres are of different colours or shades. For this reason the defect can often be observed after the dyeing of the core yarn, since the receptivity of the core material for the dye is usually different from that of the fibres constituting the outer layers of the core yarn; Union dyeing of the core material and the covering fibres is thus, in many cases, difficult or impracticable, since the incompletely covered dyed core material can be seen through the dyed outer fibres and the yarn has an undesirable flecked or streaked appearance. This appearance has restricted the use of core yarns mainly to novelty applications and has precluded the use of such yarns to a large extent in woven and knitted fabrics, even though the core material has imparted higher tensile strength and other desirable physical properties to the yarns.

It is an important object of this invention to provide a method and apparatus for the production of core yarns free from the foregoing and other disadvantages.

According to the present invention, a process for the production of core yarns comprises rotating a yarn package support for twisting and winding thereon filamentary material, drafting a plurality of spaced rovings of staple fibres, positively feeding the spaced and drafted rovings to a common point and thence to said rotating package support and positively and simultaneously feeding a yarn through said common point to said package support at a lower linear speed than said spaced and drafted rovings, whereby the rotation of said package support twists the resulting composite filamentary material and wraps said staple fibres round said yarn. By feeding the yarn constituting the core material to the rotating yarn package support between and spaced from the spaced and drafted rovings, and at a positively determined lower linear speed, it can be ensured that the core material is fully covered by the staple fibres constituting

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the roving. It is desirable to carry out the process defined above simultaneously with the drafting of the rovings, the rovings being drafted immediately before being fed to the yarn package support. The yarn constituting the core material can then be fed between the rovings by supplying it to a groove in one of the last pair of drafting rolls by which the rovings are drafted.

An apparatus according to the invention for the production of core yarn in the manner described above comprises means for rotating a yarn package support for twisting and winding thereon filamentary material fed thereto, spaced guide means for receiving and spacing a plurality of rovings of staple fibre, a common guide for said rovings, means for positively feeding drafted rovings spaced by said spaced guide means through said common guide to said package support, and means for positively feeding a yarn through said common guide to said package support at a linear speed lower than the linear speed of said spaced and drafted rovings. The apparatus preferably comprises also a set of drafting rolls adapted to receive the plurality of rovings from the spaced guide means, to draft said rovings in spaced condition, and to feed the drafted rovings in spaced condition to the common guide. Thus, the drafting rolls may be adapted to draft a pair of rovings in spaced condition, and the core material can be fed between the last pair of drafting rolls and between said rovings, but at a lower speed than said rolls and said rovings. This can be done by forming a circumferential groove in one of the last pair of drafting rolls to allow the passage of the core material. Preferably the grooved roll is the upper roll of the pair, the core material being supplied between the last pair of drafting rolls by a pair of feed rolls disposed above said drafting rolls.

The invention can be carried out by modifying an existing spinning frame, by feeding a pair of spaced rovings of staple fibres through the drafting rolls of the spinning frame to the balloon guide of the ring twisting device of said frame, while the yarn which is to constitute the centre or core of the core yarn is fed at a predetermined speed between the spaced rovings to said balloon guide, and is there combined with the drafted rovings. The resulting composite filamentary material is twisted, as it passes to the spinning bobbin, to produce the core yarn. Core yarns produced according to this invention comprise a central core substantially completely covered by staple fibres. When dyed such core yarns present a pleasing, uniform unstreaked appearance.

The process and apparatus of this invention may be used with a wide variety of textile fibres, and are particularly suitable for use with synthetic textile fibres, such as fibres of cellulose acetate or other cellulose esters or ethers; fibres of polyamides such as nylon; fibres of vinyl polymers such as polyvinyl alcohol or the polymers and copolymers of acrylonitrile, vinyl chloride and ethylene; fibres of polyesters such as polyethylene terephthalate; cellulose fibres such as viscose rayon or high tenacity fibres of saponified stretched cellulose acetate, or fibres made from rubber latex. It is desirable, for best results, to employ a yarn of continuous filaments as the central portion, or core, of the core yarn. Thus, excellent results have been obtained when the yarn making up the central core is composed of continuous filaments of cellulose acetate, saponified stretched cellulose acetate or nylon while the rovings are made up of staple fibres of cellulose acetate, each staple fibre having a denier of about 2 or 3 and an average length of about 2 inches, said rovings having a total denier of the order of about 900 to 5,300 each, for example, and having a small amount of twist, e.g., a twist of 0.8 to 2.0 turns per inch. It has been found advantageous to employ a yarn of continuous filaments which has no initial twist or which has an initial twist in a direction which is the same as the direction in which the composite or core yarn is to be twisted. However, if desired, the initial twist of the yarn which is to constitute the central core may be in a direction opposite to the direction in which this yarn and the drafted rovings are to be twisted together.

As is well known, it is not possible, on a practical basis, to produce very fine yarns, i.e., yarns of high count, composed of staple fibres which have only moderate tenacities, e.g., cellulose acetate. However, by the use of the present invention there have been produced, on a practical scale, very fine core yarns comprising continuous filaments of cellulose acetate surrounded by staple fibres of the same material. These core yarns are much finer than yarns produced solely from staple fibres of cellulose acetate and have properties superior to those of such staple fibre yarns, though having a similar general appearance. Other specific examples of core yarns which may be produced according to this invention include core yarns composed of one or more continuous filaments of rubber surrounded by staple fibres of other material, e.g., cellulose acetate or viscose rayon; core yarns composed of spun or continuous filament yarns of polyethylene terephthalate surrounded by blends of cellulose acetate staple fibres and wool fibres; core yarns composed of continuous filaments of cellulose acetate surrounded by blends of nylon and cellulose acetate staple fibres; core yarns composed of continuous filaments of polyethylene terephthalate or nylon covered by staple fibres of polyvinyl alcohol; and core

yarns composed of continuous filaments of stretched cellulose acetate, either saponified or not, covered by a blend of staple fibres of cotton and stretched saponified cellulose acetate.

Although this invention is particularly applicable to the spinning of yarn, it may also be employed for the production of cored products heavier than are generally designated by this term, e.g., of the weight usual in rovings. This can be done, for example by introducing into a conventional roving frame two spaced ends of sliver, having a denier of, for example, about 12,000 to 45,000 (instead of one end of the sliver), while introducing a yarn, between said ends of sliver, through a circumferential groove cut into the top front roll of the roving frame. Accordingly, the term 'rovings' employed herein must be considered as covering draftable staple fibre products generally, including slivers, and the term "core yarn" as covering products which, though not drafttable, have the weight usually associated with rovings.

It is to be understood that, while the invention has been described using a ring and traveller for effecting the twisting of the yarn and the drafted fibres, this twisting operation may be carried out in any other suitable manner, e.g., by the use of a cap-spinning or flyer-spinning device. In addition, the drafting rolls of the spinning frame may be provided, if desired, with one or more of the aprons conventionally employed with such rolls.

By way of example, one form of apparatus according to the invention will now be described in greater detail with reference to the accompanying drawing, which is a simplified view, mainly in perspective, of the apparatus.

In the drawing, 11,12 and 13,14 and 16,17 are three successive pairs of drafting rolls of a spinning frame, while 18 designates generally a ring twisting unit of the spinning frame. The lower rolls 11, 13 and 16 are fluted, metallic positively driven rolls, while the upper rolls 12, 14 and 17 are covered rolls, pressed against the lower rolls in any suitable manner, as by weights (not shown) and driven by frictional contact with the lower rolls, all in a manner well known to the art. The spinning frame is of the type employed for the spinning of ordinary yarn, with the following exceptions: Mounted on the spinning frame, above and slightly behind the front drafting rolls 16,17 is an independently driven feed roll 19 for supplying a yarn 21, which is to constitute the centre, or core, of the core yarn, to the front drafting rolls. Riding on the feed roll 19, and pressed against it in any suitable manner, as by means of a weight (not shown), is a top roll 22, covered with suitable material such as cork or synthetic rubber, while above the nip of the rolls 19 and 22 there is mounted a guide 23 for receiving the yarn 21 from a suitable source. The covering, or cot 24, of the upper front roll 17 is formed with a narrow circumferential groove 26 of width and depth sufficient to accommodate the yarn 21 so that the yarn can pass through said groove at a speed independent of the speed of the front roll 17. Behind the rear drafting rolls 11,12 are mounted a pair of spaced funnel-shaped guides or trumpets 27 and 28 for receiving a pair of spaced rovings 29 and 31 of staple fibre; these two trumpets 27,28 replace the single trumpet usually employed on spinning frames. It is to be understood, that a conventional spinning frame comprises a large number of identical spinning positions for spinning a correspondingly large number of yarns, and that the changes indicated above may be made at one, several, or all of said spinning positions, as desired. Advantageously, the roll 19 extends the entire length of the spinning frame while separate rolls 22 are provided for each spinning position. Thus, each roll 22 may be raised to stop the feed of the yarn 21 fed thereby without interfering with the feed of similar yarns at other spinning positions, so that it is easy to start-up or to replace a broken yarn at any one spinning position without affecting the other spinning positions.

To start the operation of spinning the core yarn, the yarn 21 is threaded through the guide 23, the nip of the rotating rollers 19 and 22, the groove 26 in the upper front roll 17 and the balloon guide 32 and traveller 33 of the ring twister 18 and is thrown-on to an empty driven bobbin 34 mounted in the ring twister. Advantageously, the bobbin 34 is held stationary, as by a brake, when the yarn 21 is thrown-on and is then allowed to rotate so as to wind the yarn on the bobbin. The rovings 29 and 31 are drawn from suitable separate sources through the guides 27 and 28, between the successive pairs of rotating drafting rolls 11,12 and 13,14 to the nip of the rotating front rolls 16,17, the rovings being maintained in spaced condition. The drafted rovings emerging from the nip of the front rolls 16,17 are then thrown-on, manually or by any suitable mechanical device, to the yarn 21 travelling to the balloon guide 32, so causing the drafted rovings to begin to twist round said yarn 21. Thereafter, the rate of feed of the yarn 21 is adjusted relatively to the rate of feed of the drafted rovings in order to ensure that in the resulting core yarn the central core is completely covered. The adjustment of the feed rates may be accomplished by maintaining the speeds of the drafting rolls 11,12,13,14,16,17 constant while regulating the speed of the feed roll 19, which feed roll may be driven in any suitable manner, e.g., through a train of gears connected to the driven front roll

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The rate at which it is necessary to drive the feed roll 19 in order to obtain a core yarn in which the yarn 21 is substantially completely covered by the staple fibres of the rovings 29 and 31 depends on such factors as the type, fineness and weight per unit length of the rovings 29 and 31 and similar parameters of the yarn 21. However, the correct rate can be determined in any instance in a simple manner by examining the core yarn being produced and varying the speed of the feed roll 19 accordingly. Examination of the core yarn to determine completeness of covering is particularly easy when the core material and the covering fibres are of different colours, e.g., when the rovings are made of pigmented fibres. When inspection of the core yarn shows that the central thread is not completely covered the speed of the feed roll 19 is decreased, while when the amount of coverage is greater than that desired the speed of the feed roll 19 may be increased. For example, core yarns in which the central yarn is completely covered have been obtained driving the feed roll 19 at a linear speed which is about 80% to 98% of the linear speed of the front rolls 16,17. After the ratio of these two speeds has been determined by preliminary trials for any given rovings and yarns and in any given spinning conditions, this ratio is maintained constant during the spinning operation.

Because of the presence of the groove 26, the front roll 17 acts as a guide for directing the yarn 21 substantially into the plane of the drafted rovings without substantially affecting the speed of said yarn 21. Naturally, the groove must be larger when a thick yarn 21, such as a rubber yarn, is employed, than when a fine yarn such as fine nylon yarn, is used.

The following example is given to illustrate this invention further.

EXAMPLE

A pair of rovings, each of 1,300 denier, and each composed of pigmented black crimped staple fibres of cellulose acetate, said fibres having an average denier of about 2 and an average length of about 2 inches, are fed to the rear rolls of a ring-spinning frame modified in accordance with this invention, which spinning frame is provided with an apron, of conventional construction for supporting the rovings between the front rolls and the drafting rolls just behind the front rolls. The rear rolls of the spinning frame are driven at 1.3 feet per minute, while the front rolls are driven at 33.8 feet per minute. A yarn of white continuous filaments of stretched saponified cellulose acetate of high tenacity, said yarn having a denier of 30, is fed to the groove in said front rolls at a speed of 32 feet per minute and is thrown-on to the spinning bobbin of the frame, which is rotated at 9,000 revolutions per minute. The drafted rovings leaving the front rolls of the spinning frame are then thrown-on to the yarn of continuous filaments passing to the spinning bobbin. The resulting core yarn has a uniform black appearance, the white central thread being completely and uniformly covered by the black pigmented staple fibres.

What we claim is:—

1. Process for the production of core yarns which comprises rotating a yarn package support for twisting and winding thereon filamentary material, drafting a plurality of spaced rovings of staple fibres, positively feeding the spaced and drafted rovings to a common point and thence to said rotating package support and positively and simultaneously feeding a yarn through said common point to said package support at a lower linear speed than said spaced and drafted rovings, whereby the rotation of said package support twists the resulting composite filamentary material and wraps said staple fibres round said yarn.

2. Process according to Claim 1 comprising feeding the yarn between and spaced from the spaced and drafted rovings.

3. Process according to Claim 2 comprising feeding a pair of spaced rovings and feeding the yarn between and in the same plane as said rovings.

4. Process according to any of the preceding claims comprising drafting the rovings immediately before feeding them to the package support.

5. Process according to Claim 4 comprising feeding the yarn through a groove in one of the last pair of drafting rollers by which the rovings are drafted.

6. Process according to any of the preceding claims wherein the yarn is a continuous filament yarn.

7. Process for the production of core yarns substantially as described.

8. Apparatus for the production of core yarns, said apparatus comprising means for rotating a yarn package support for twisting and winding thereon filamentary material fed thereto, spaced guide means for receiving and spacing a plurality of rovings of staple fibre, a common guide for said rovings, means for positively feeding drafted rovings spaced by said spaced guide means through said common guide to said package support, and means for positively feeding a yarn through said common guide to said package support at a linear speed lower than the linear speed of said spaced and drafted rovings.

9. Apparatus according to Claim 8 comprising a set of drafting rolls adapted to receive the plurality of rovings from the spaced guide means, to draft said rovings in spaced condition, and to feed the drafted rovings in spaced condition to the common

guide.

10. Apparatus according to Claim 9 comprising drafting rolls adapted to draft a pair of rovings and means for feeding the yarn between the last pair of drafting rolls and between said rovings but at a lower speed than said rolls and said rovings.

11. Apparatus according to Claim 10 wherein one of the last pair of drafting rolls is circumferentially grooved to allow the passage of the yarn.

12. Apparatus according to Claim 11 wherein the upper roll is grooved, said apparatus comprising a pair of feed rolls for the yarn, disposed above the last pair of drafting rolls.

13. Apparatus according to any of the preceding claims comprising a plurality of guide funnels as the spaced guide means.

14. Apparatus for the production of cored yarns substantially as shown in the accompanying drawings.

15. Apparatus for the production of cored yarns substantially as described.

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1 SHEET

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale